IN THE SPECIFICATION:

Please amend the paragraph beginning at **line 21 of page 5** to read as follows:

--FIG. 25A, which is shown expanded in FIG. 25B, shows a respective top view and top expanded view of another embodiment of an optical waveguide device including a gate electrode ~~configured~~ configuration that may be configured as an Echelle diffraction grating or an Echelle lens grating;--

Please amend the paragraph beginning at **line 25 of page 5** to read as follows:

--FIG. 26 shows a top cross sectional view taken within the waveguide of the optical waveguide device illustrating the diffraction of optical paths as light passes through the actuated Echelle diffraction grating shown in FIG. 25A, wherein the projected outline of the region of changeable propagation constant from the Echelle diffraction grating is shown;--

Please amend the paragraph beginning at **line 6 of page 6** to read as follows:

--FIG. 28 shows a top cross sectional view taken through the waveguide of the optical waveguide device illustrating the focusing of multiple optical paths as light passes through the actuated Echelle lens grating shown in FIG. 25A, illustrating the region of changeable propagation constant resulting from the Echelle lens grating;--

Please amend the paragraph beginning at **line 12 of page 6** to read as follows:

--FIG. 30B shows a top view of one embodiment of an optical waveguide device that includes a grating, and is configured to act as an optical lens;--

Please amend the paragraph beginning at **line 14 of page 6** to read as follows:

--FIG. 30A shows a top cross sectional view taken through the waveguide of the optical waveguide device shown in FIG. 30B illustrating light passing through the waveguide;--

Please amend the paragraph beginning at **line 16 of page 6** to read as follows:

--FIG. 31B shows a top view of another embodiment of an optical waveguide device that includes a filter grating, and is configured to act as an optical lens;--

Please amend the paragraph beginning at **line 18 of page 6** to read as follows:

--FIG. 31A shows a top cross sectional view taken through the waveguide of the optical waveguide device shown in FIG. 31B illustrating light passing through the waveguide;--

Please amend the paragraph beginning at **line 20 of page 6** to read as follows:

--FIG. 32B shows a top view of another embodiment of an optical waveguide device that includes a grating, and is configured to act as an optical lens;--

Please amend the paragraph beginning at **line 22 of page 6** to read as follows:

--FIG. 32A shows a top cross sectional view taken through the waveguide of the optical waveguide device shown in FIG. 32B;--

Please amend the paragraph beginning at **line 20 of page 59** to read as follows:

--FIG. 25A shows one embodiment of Echelle grating 2500. The Echelle grating 2500 may be used alternatively as a diffraction grating or a lens grating depending on the biasing of the gate electrode. The Echelle grating 2500 is altered from the FIGs. 1 to 3 and 5 embodiment of optical waveguide device 100 by replacing the rectangular gate electrode by a triangular-shaped Echelle gate electrode 2502. The Echelle-shaped gate electrode 2502 includes two parallel sides 2504 and 2506 (side 2506 is shown as the point of the triangle, but actually is formed from a length of material shown in FIG. 26 as 2506), a base side 2510, and a planar grooved surface 2512.--

Please amend the paragraph beginning at **line 11 of page 60** to read as follows:

--The rise portion 2517 defines the difference in distance that each individual groove rises from its neighbor groove. The rise portion 2517 for all of the individual grooves 2515 are equal, and the rise portion 2517 equals some integer multiple of the

wavelength of the light that is to be acted upon by the Echelle grating 2500. Two exemplary adjacent grooves are shown as 2515a and 2515b, so the vertical distance between the grooves 2515a and 2515b equals 2517. The width portion 2519 of the Echelle shape gate electrode 2502 is equal for all of the individual grooves. As such, the distance of the width portion 2519 multiplied by the number of individual grooves 2515 equals the operational width of the entire Echelle shaped gate electrode. Commercially available three dimensional Echelle gratings that are formed from glass or a semiconductor material have a uniform cross section that is similar in contour to the Echelle shaped gate electrode 2502. The projected region of changeable propagation constant 190 can be viewed generally in cross-section as having the shape and dimensions of the gate electrode (including grooves), and extending vertically through the entire thickness of the waveguide 106. The numbers of individuals grooves 2515 in the FIG. 25A embodiment of Echelle shaped gate electrode 2502 may approach many thousand, and therefore, the size may become relatively small to provide effective focusing.--

Please amend the paragraph beginning at **line 1 of page 61** to read as follows:

--FIG. 26 shows the top cross sectional view of region of changeable propagation constant 190 shaped as an Echelle grating 2500. The waveguide 106 is envisioned to be a slab waveguide, and is configured to permit the angular diffraction of the beam of light emanating from the Echelle grating 2500. When voltages are applied to the FIG. 25A embodiment of Echelle shaped gate electrode 2502, a projected region of changeable propagation constant 190 of the general shape shown in FIG. 26 is established within the waveguide 106. Depending upon the polarity of the applied voltage to the Echelle shaped gate electrode in FIG. 25A, the propagation constant within the projected region of changeable propagation constant 190 can either exceed, or be less than, the propagation constant within the waveguide outside of the projected region of changeable propagation constant 190. The relative level of propagation constants within the projected region of changeable propagation constant 190 compared to outside of the projected region of changeable propagation constant determines whether the waveguide 106 acts to diffract light or focus light. In this section, it is assumed that the voltage

applied to the gate electrode is biased so the Echelle grating acts to diffract light, although equivalent techniques would apply for focusing light, and are considered a part of this disclosure.--

Please amend the paragraph beginning at **line 17 of page 61** to read as follows:

--In FIG. 26, three input light beams 2606, 2607, and 2609 extend into the waveguide. The input light beams 2606, 2607 and 2609 are shown as extending substantially parallel to each other, and also substantially parallel to the side surface 2520 of the projected region of changeable propagation constant 190. The projected region of changeable propagation constant 190 as shown in FIG. 26 precisely mirrors the shape and size of the FIG. 25<u>A</u> embodiment of Echelle shaped gate electrode 2502. As such, the projected region of changeable propagation constant 190 can be viewed as extending vertically through the entire thickness of the waveguide 106. The numbers of individual grooves 2505 in the FIG. 25<u>A</u> embodiment of Echelle shaped gate electrode 2502 may approach many thousand to provide effective diffraction, and therefore, individual groove dimensions are relatively small. It is therefore important that the projected region of changeable propagation constant 190 precisely maps from the Echelle shaped gate electrode 2502.--

Please amend the paragraph beginning at **line 21 of page 62** to read as follows:

--The middle input light beam 2607 enters the projected region of changeable propagation constant 190 and travels through a considerable distance d2 before exiting from the Echelle grating. If there is no voltage applied to the gate electrode, then the output light will be unaffected by the region of changeable propagation constant 190 as the light travels the region, and the direction of propagation for light following input path 2607 will be consistent within the waveguide along 2612a. If a voltage level is applied to the FIG. 25<u>A</u> embodiment of gate electrode 2502, then the propagation constant within the region of changeable propagation constant 190 is changed from that outside the region of changeable propagation constant. The propagation constant in the region of changeable propagation constant 190 will thereupon diffract light passing form the input

light beam 2607 through an angle θ_{d1} along path 2612b. If the voltage is increased, the amount of diffraction is also increased ~~to~~ along the path shown at 2612c.--

Please amend the paragraph beginning at **line 16 of page 64** to read as follows:

--The FIG. 25A embodiment of Echelle grating 2500 can be used not only as a diffraction grating as described relative to FIG. 26, but the same structure can also be biased to perform as a lens to focus light. To act as a lens, the polarity of the voltage of the Echelle grating 2500 applied between the gate electrode and the combined first body contact/second body contact electrodes is opposite that shown for the FIG. 26 embodiment of the diffraction grating.--

Please amend the paragraph beginning at **line 22 of page 64** to read as follows:

--FIGs. 28 and 29 show three input light beams that extend into the region of altered propagation constant 190 in the waveguide are shown as 2806, 2807, and 2809. The input light beams 2806, 2807, and 2809 are shown as extending substantially parallel to each other, and also substantially parallel to the side surfaces 2520, 2522 of the projected region of changeable propagation constant 190. The projected region of changeable propagation constant 190 shown in FIGs. 28 and 29 generally mirrors vertically through the height of the waveguide the shape and size of the FIG. 25A embodiment of Echelle shaped gate electrode 2502.--

Please amend the paragraph beginning at **line 9 of page 67** to read as follows:

--FIG. 30B shows another embodiment of an optical waveguide device 100 including a grating 3008 that is used as a lens to focus light passing through the waveguide. The embodiment of optical waveguide device 100, or more particularly the FIG. 2 embodiment of the gate electrode of the optical waveguide device, is modified by replacing the continuous gate electrode (in FIG. 2) with a discontinuous electrode in the shape of a grating (shown in FIG. 30B). The grating 3008 is formed with a plurality of etchings 3010 that each substantially parallels the optical path 101 of the optical waveguide device. In the FIG. 30B embodiment of grating 3008, the thickness of the successive etchings 3010 to collectively form gate electrode 120 increases toward the

center of the optical waveguide device, and decreases toward the edges 120a, 120b of the gate electrode 120. Therefore, the region of changeable propagation constant 190 in the waveguide is thicker at those regions near the center of the waveguide. Conversely, the region of changeable propagation constant 190 becomes progressively thinner at those regions of the waveguide near edges 120a, 120b. The propagation constant is a factor of both the volume and the shape of the material used to form the gate electrode. The propagation constant is thus higher for those regions of changeable propagation constant closer to the center of the waveguide.--

Please amend the paragraph beginning at **line 25 of page 67** to read as follows:

--Light is assumed to be entering the waveguide 106 following substantially parallel paths as shown by exemplary paths 3012a and 3012b. Paths 3012a and 3012b represent two paths traveling at the outermost positions of the waveguide. The locations between paths 3012a and 3012b are covered by a continuum of paths that follow similar routes. When sufficient voltage is applied to the grating shaped electrode, the light following paths 3012a and 3012b will be deflected to follow output paths 3014a and 3014b, respectively. Output paths 3014a and 3014b, as well as the paths of all the output paths that follow through the waveguide under the energized grating 3008 will be deflected a slightly different amount, all toward a focus point 3016. The FIG. 30<u>B</u> embodiment of <u>the</u> optical waveguide device therefore acts as a lens. The grating 3008, though spaced a distance from the waveguide, can be biased to direct the light in a manner similar to a lens.--

Please amend the paragraph beginning at **line 11 of page 68** to read as follows:

--The reason why the embodiment of grating <u>3008</u> shown in FIG. 30 acts as a lens is now described. Light traveling within the waveguide requires a longer time to travel across those regions of changeable propagation constant at the center (i.e., taken vertically as shown in FIG. 30<u>B</u>) that those regions adjacent the periphery of the lens (i.e., near edges 120a, 120b). This longer time results because the propagation constant is greater for those regions near the center. For light of a given wavelength, light exiting the lens will meet at a particular focal point. The delay imparted on the passing through

the regions of changeable propagation constant nearer the center of the lens will be different from that of the light passing near edges 120a, 120b. The total time required for the light to travel to the focal point is made from the combination of the time to travel through the region of changeable propagation constant 190 added to the time to travel from the region of changeable propagation constant 190 to the focal point. The time to travel through the region of changeable propagation constant 190 is a function of the propagation constant of each region of changeable propagation constant 190. The time to travel from the region of changeable propagation constant 190 to the focal point is a function of the distance from the region of changeable propagation constant 190 to the focal point. As a result of the variation in propagation constant from the center of the waveguide toward the edges 120a, 120b, a given wavelength of light arrives at a focal point simultaneously, and the lens thereby focuses the light.--

Please amend the paragraph beginning at **line 4 of page 70** to read as follows:

--FIGs. 30B and 31B show two embodiments of optical waveguide devices that perform waveguide Fresnel lens functions. The two-dimensional Fresnel lenses follow the phase modulation like their three-dimensional lens counterpart:

$$\phi_F(x) = \Delta\phi(x) + 2m\pi \qquad 13$$

for $x_m < |x| < x_{m+1}$, the phase modulation $\Delta\phi(x_m) = 2m\pi$, which is obtained by segmenting the modulation into Fresnel zones so that $\phi_F(x)$ has amplitude 2π. Under the thin lens approximation, the phase shift is given by $K\Delta nL$. Therefore, the phase of the wavefront for a specific wavelength can be controlled by the variations of Δn and L. If Δn is varied as a function of x, where the lens thickness, L, is held constant, as shown in FIG. 30B, it is called the GRIN Fresnel lens and is described by:

$$\Delta n(x) = \Delta n_{max}(\phi_F(x)/2\pi + 1) \qquad 14\text{--}$$

Please amend the paragraph beginning at **line 16 of page 70** to read as follows:

--FIG. 32B shows one embodiment of optical waveguide device 100 that operates as a gradient-thickness Fresnel lens where Δn is held constant. The thickness of the lens L has the following functional form:

$$L(x) = L_{max}(\phi_F(x)/2\pi + 1) \qquad 15\text{--}$$

Please amend the paragraph beginning at **line 20 of page 70** to read as follows:

--To have 2π phase modulation, in either the FIG. 30B or FIG. 31B embodiment of the lens, the modulation amplitude must be optimized. The binary approximation of the phase modulation results in the step-index Fresnel zone lens. The maximum efficiency of 90%, limited only by diffraction, can be obtained in certain lenses.--

Please amend the paragraph beginning at **line 25 of page 70** to read as follows:

--Another type of optical waveguide device has been designed by spatially changing the *K*-vector as a function of distance to the central axis, using a so-called chirped grating configuration. In chirped grating configurations, the cross sectional areas of the region of changeable propagation constant 190 are thicker near the center of the waveguide than the periphery to provide a greater propagation constant as shown in the embodiment of FIG. 30B. Additionally, the output of each region of changeable propagation constant 190 is angled towards the focal point to enhance the deflection of the light toward the deflection point. This architecture of FIG. 32B embodiment of the chirped grating waveguide lens results in index modulation according to the equation:

$$\Delta n(x) = \Delta n \cos[\Delta\phi(x)] = \Delta n \cos\{Kn_e[Kn_e(f - \sqrt{x^2 + f^2})]\} \qquad 16\text{--}$$

Please amend the paragraph beginning at **line 19 of page 71** to read as follows:

--In the embodiment of the optical waveguide device as configured in FIG. 32B, adjustments may be made to the path length of the light passing through the waveguide by using a gate electrode formed with compensating prism shapes. Such compensating prism shapes are configured so that the voltage taken across the gate electrode (from the side of the gate electrode adjacent the first body contact electrode to the side of the gate electrode adjacent the second body contact electrode) varies. Since the voltage across the

gate electrode varies, the regions of changeable propagation constant will similarly vary across the width of the waveguide. Such variation in the voltage will likely result in a greater propagation of the light passing through the waveguide at different locations across the width of the waveguide.--